GEOLOGY, ENERGY, AND MINERAL (GEM) RESOURCE ASSESSMENT OF THE PEDRO-SEMINOE GEM RESOURCE AREA (GRA), WYOMING, INCLUDING THE PEDRO MOUNTAINS WILDERNESS STUDY AREA (WY-030-305), AND THE BENNETT MOUNTAINS WILDERNESS STUDY AREA (WY-030-304)

PHASE I

Contract No. YA-553-CT2-1055

Prepared for:

U.S. Bureau of Land Management

Prepared by:

Tetra Tech, Inc.
Pasadena, California

September 1983

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EXECUTIVE SUMMARY

The U.S. Bureau of Land Management (BLM) has adopted a two-phase procedure for the integration of geologic, energy, and mineral (GEM) resources data concerning Wilderness Study Areas (WSAs). To facilitate this review, certain WSAs with similar geologic environments and mineral characteristics have been grouped together into larger GEM Resource Areas (GRAs). Using these guidelines, the Pedro Mountains and Bennett Mountains WSAs were combined into the larger Pedro-Seminoe GRA. This report, which terminates the Phase I activities for the Pedro-Seminoe GRA, is an evaluation and interpretation of existing data concerning the GEM resource potential of the Pedro Mountains and Bennett Mountains WSAs.

The Pedro-Seminoe GRA contains two WSAs: the Pedro Mountains WSA (WY-030-305), and the Bennett Mountains WSA (WY-030-304). Both WSAs are in the BLM's Medicine Bow Resource Area, Rawlins District, Wyoming.

The Pedro Mountains WSA is considered to have a low favorability based on indirect evidence for the potential occurrence of metallic and strategic minerals (classified 2B); this classification is based on the presence of an unfavorable geologic environment for these resources in the WSAs. Indirect evidence from geologic mapping (Love et al., 1979), a brief field reconnaissance, and other available resource occurrences support this classification. The Pedro Mountains WSA is considered to have a moderate favorability based on indirect evidence for the potential occurrence of jade and beryl (classified 3B). This classification is based upon the presence of favorable rock types for mineral occurrences, and references citing mineral occurrences in the area (Sherer, 1970; Sinkankas, 1976).

The Pedro Mountains WSA is considered to have a moderate to high favorability for the potential occurrence of uranium resources (classified 3D and 4D); these classifications are based on abundant direct information. Potential uranium resources are classified 3D (or moderate favorability) in Precambrian and Miocene sedimentary rocks, and 4D (or high favorability) in the Precambrian rocks of the Heath Peak area. These classifications are based upon high radiometric backgrounds in the Pedro Mountains granitic rocks, the

identification of numerous uranium occurrences in the area (Griffin and Milton, 1980), and past production from the Little Man Mine (Osterwald et al., 1966).

The Bennett Mountains WSA is considered to have a moderate favorability for the potential occurrence of metallic and strategic minerals (classified 3B); this classification is based upon the probable occurrence of rock types in the Precambrian rock of the Bennett Mountains that are similar to those that occur in the nearby Western Seminoe Mountains where significant occurrences of metallic and strategic minerals are found. The Bennett Mountains WSA is considered to have a moderate favorability based on indirect evidence for the potential occurrence of jade and beryl as gemstones (classified 3B); this classification is based on the presence of favorable rock types for mineral occurrences, and upon references to similar mineral occurrences in the area (Sherer, 1970; Sinkankas, 1976). The Bennett Mountains WSA is considered to have a moderate favorability based on direct, but quantitatively minimal evidence, for the occurrence of limestone (classified 3C). This limestone classification occurs in the Southern Bennett Mountains where the Madison Limestone outcrops; this outcrop has been mapped (Allspach, 1955; Love et al., 1979), and identified in the field.

Finally, the Bennett Mountains are considered to have a moderate favorability based on indirect evidence for the potential occurrence of uranium resources (classified 3B). This uranium resource would be associated with the Granite Mountains fault system and favorable rock types (Griffin and Milton, 1980).

For both the Pedro Mountains and Bennett Mountains WSAs, there exists quantitatively minimal direct evidence to support a low favorability classification for the potential occurrence of other GEM resources (classified 2C). This classification is based in part on the geologic environment and the inferred geologic processes that have been identified within the WSA. The occurrence of paleontologic resources is considered moderately favorable in the Tertiary units within the WSAs.

Additional geologic investigations would help supplement the GEM resource evaluation of the Pedro-Seminoe GRA. At the present time, the available information is sparse and inadequate. Additional geologic mapping and geochemical sampling is strongly recommended to allow for more accurate differentiation and classifications of the wide variety of Precambrian rock types in the area. There exists a minimal amount of geologic data concerning the study area; the available information should be reviewed by BLM personnel prior to making wilderness decisions.

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GEM RESOURCE AREA

PEDRO-SEMINOE

1.0 INTRODUCTION

1.1 Purpose of Study

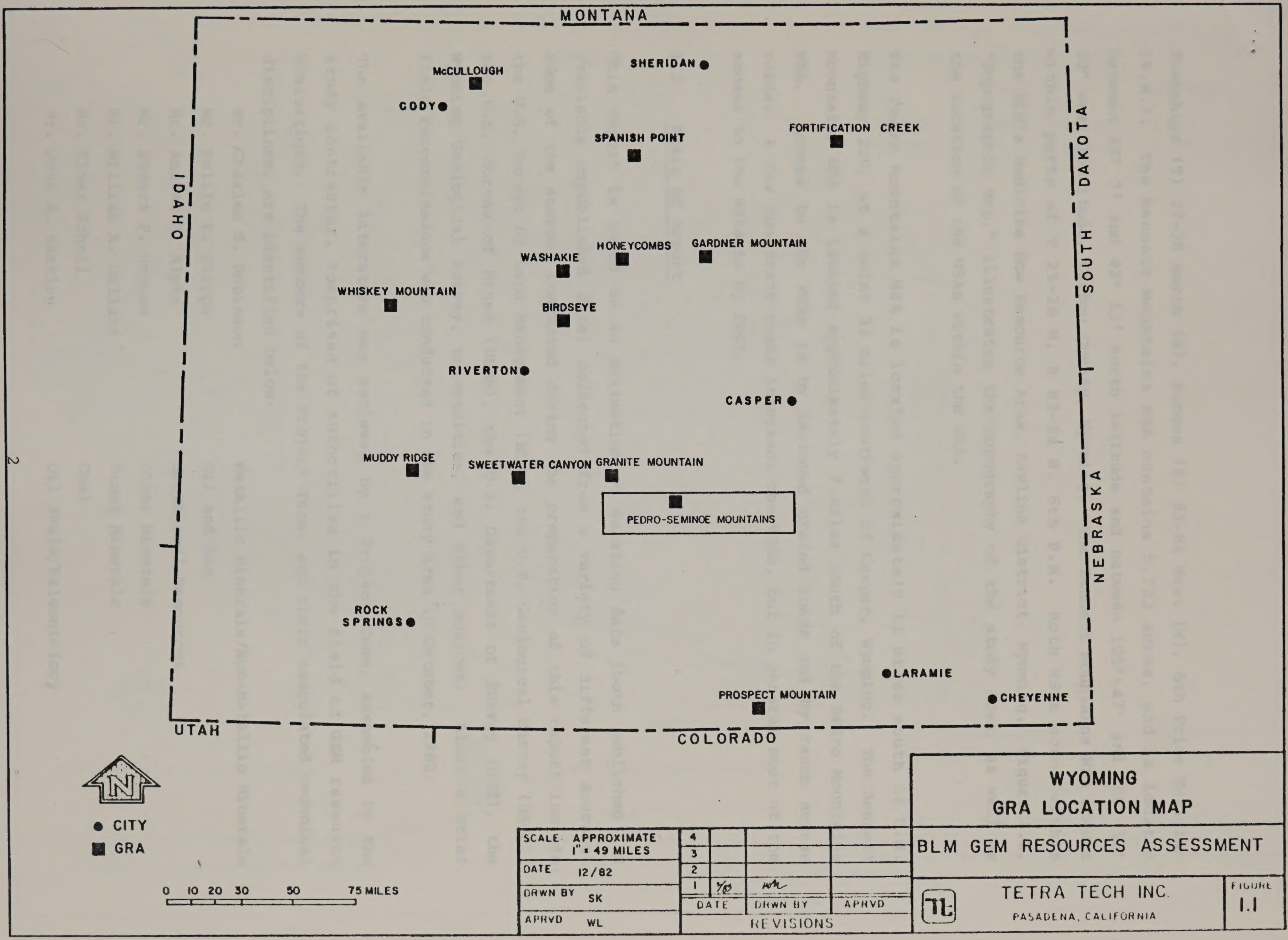
The U.S. Bureau of Land Management (BLM) has adopted a two-phase procedure for the integration of geologic, energy, and mineral (GEM) resources data for suitable/nonsuitable decisions concerning Wilderness Study Areas (WSAs). Phase I consists of a review and evaluation of existing data, resulting in an interpretation of the GEM resource potential in the WSAs. Phase II is designed to generate only the additional data required to support the GEM resource recommendations presented during Phase I. To facilitate this review, certain WSAs with similar geologic environments and mineral characteristics have been grouped together into larger GEM Resource Areas (GRAs). Using these guidelines, the Pedro Mountains and Bennett Mountains WSAs were combined into the larger Pedro-Seminoe GRA. This report, which terminates the Phase I activities for the Pedro-Seminoe GRA, is an evaluation and interpretation of existing data concerning the GEM resource potential in the Pedro Mountains and Bennett Mountains WSAs.

The GEM resource evaluations for this study were performed by Tetra Tech, Inc. for the U.S. Bureau of Land Management, under Contract No. YA-553-CT2-1055. This study was completed in January, 1983.

1.2 Location and Access

This GEM report covers the area identified as the Pedro-Seminoe GEM Resource Area (GRA); the geographic location of the study area is shown in Figure 1.1, "GRA Location Map."

The Pedro-Seminoe GRA contains two Wilderness Study Areas: the Pedro Mountains WSA (WY-030-305), and the Bennett Mountains WSA (WY-030-304). The Pedro Mountains WSA contains 5,990 acres, and is located between 42° 16' and 42° 23' north latitude and between 106° 47' and 106° 55' west longitude, Carbon County, Wyoming. The Pedro Mountains WSA occurs within parts of



WYOMING
GRA LOCATION MAP

BLM GEM RESOURCES ASSESSMENT

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PASADENA, CALIFORNIA

FIGURE 1.1

SCALE	APPROXIMATE 1" = 49 MILES
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REVISIONS

Townships (T) 27-28 North (N), Ranges (R) 83-84 West (W), 6th Prime Meridian (P.M.). The Bennett Mountains WSA contains 5,722 acres, and is located between 42° 7' and 42° 11' north latitude and between 106° 47' and 106° 52' 30" west longitude, Carbon County, Wyoming. The Bennett Mountains WSA occurs within parts of T 25-26 N, R 83-84 W, 6th P.M. Both WSAs occur within the BLM's Medicine Bow Resource Area, Rawlins District, Wyoming. Figure 1.2, "Topographic Map," illustrates the topography of the study area, as well as the location of the WSAs within the GRA.

The Pedro Mountains WSA is located approximately 11 miles south of U.S. Highway 220, at a point 32 miles southwest of Casper, Wyoming. The Bennett Mountains WSA is located approximately 7 miles south of the Pedro Mountains WSA. Access to the WSAs is by improved graded roads and by ranch access roads. A few two track roads intersect the WSAs, but in general most of the access to the WSAs is by foot.

1.3 Basis of Report

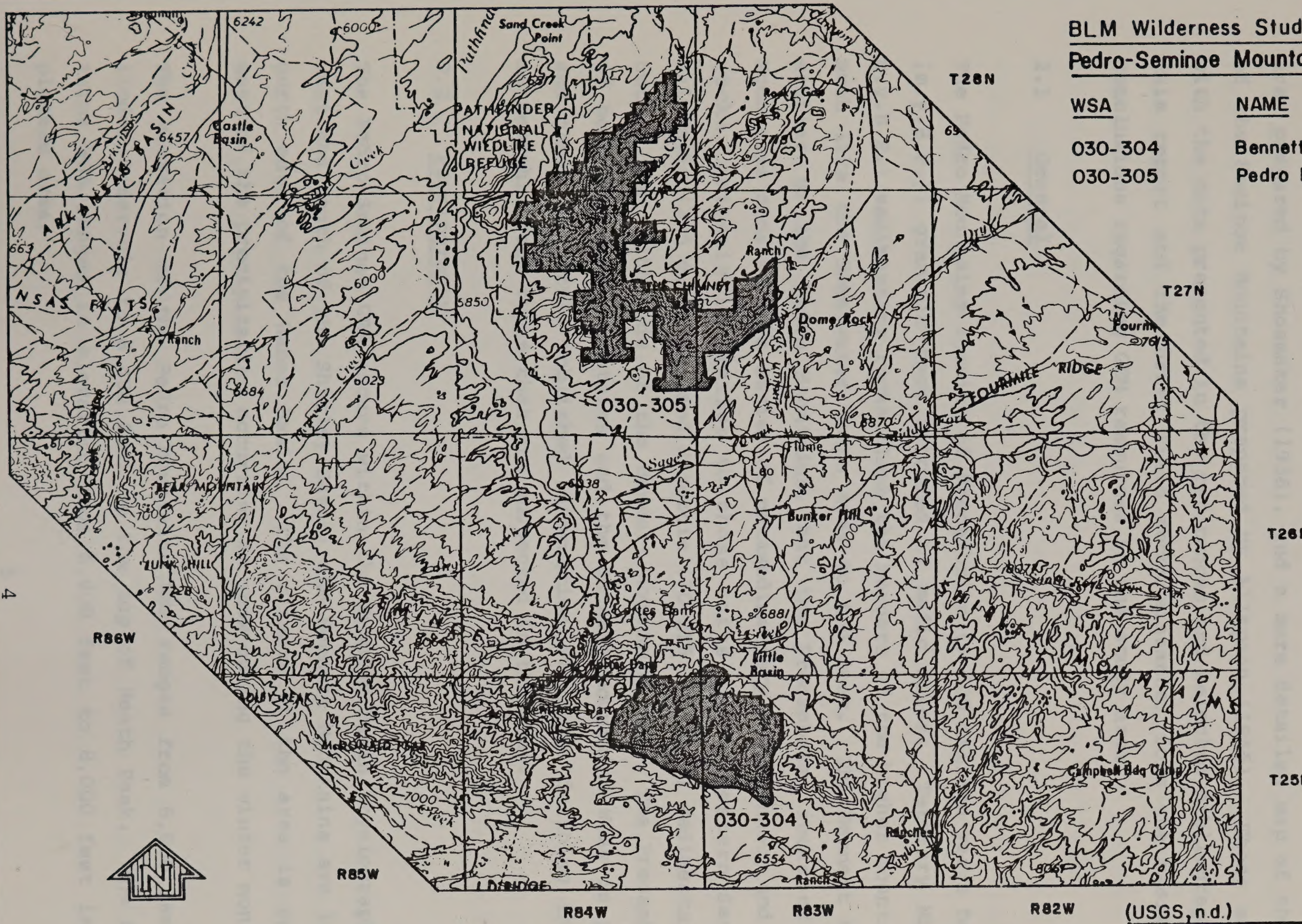
This report is based on an evaluation of existing data (both published and available unpublished data) collected from a variety of different sources. Some of the sources contacted during the preparation of this report include the U.S. Bureau of Land Management (BLM), the U.S. Geological Survey (USGS), the U.S. Bureau of Mines (USBM), the U.S. Department of Energy (DOE), the Wyoming Geological Survey, universities, and other sources. Also, a brief field reconnaissance was conducted in the study area in October, 1982.

The available literature was reviewed by a Project Team, assembled by the study contractor, comprised of authorities in the field of GEM resource evaluations. The members of the Project Team, and their associated technical disciplines, are identified below:

Mr. Charles S. Robinson	Metallic Minerals/Non-Metallic Minerals
Mr. Rollin E. Phipps	Oil and Gas
Mr. Andrew G. Alpha	Geothermal Resources
Mr. Stuart P. Hughes	Other Minerals
Mr. William A. Gallant	Other Minerals
Mr. Elmer Schell	Coal
Mr. John A. Hartley	Oil Shale/Paleontology

BLM Wilderness Study Areas Included in the Pedro-Seminoe Mountains GRA

WSA	NAME	ACREAGE
030-304	Bennett Mountains	5,722
030-305	Pedro Mountains	5,990



(USGS, n.d.)

NOTE: Contours in 200 ft. Intervals

▨ Approximate Boundary of Wilderness Study Area

5 4 3 2 1 0 3 6 Miles

5 4 3 2 1 0 5 10 Kilometers

SCALE: 1" = 4 MILES 1: 250,000	4			
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Pedro-Seminoe Mountains GRA, Wyoming

TOPOGRAPHIC MAP

BLM GEM RESOURCES ASSESSMENT
REGION 6 WYOMING and MONTANA

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PASADENA, CALIFORNIA

FIGURE 1.2

2.0 GEOLOGY

The geology of both WSAs is illustrated on the Casper 1° x 2° geologic map (Love et al., 1979). The information on this geologic map has been supplemented by a more detailed map of the Eastern Seminoe or Bennett Mountain area prepared by Shoemaker (1936), and a more detailed map of the South Flank of the Seminoe Mountains prepared by Allspach (1955). These maps, together with the data presented in the references and selected bibliography section of this report and the brief field reconnaissance, form the basis for certain conclusions regarding GEM resources in the study area.

2.1 General

The Pedro Mountains consist of Precambrian (> 600 million years before present [m.y.B.P.]) granitic rock intruded by mafic dikes. Tertiary Miocene (11-25 m.y.B.P.) sedimentary rocks flank the borders of the higher mountainous areas, much like the Sweetwater Rocks area to the west. The Bennett Mountains are similar to the Pedro Mountains, but the Precambrian rocks of the Bennett Mountains consist of a series of metasedimentary, metaigneous and metavolcanic rocks, potentially similar to those units in the Western Seminoe Range. Paleozoic (225 m.y.B.P.) and Mesozoic (70-225 m.y.B.P.) sedimentary rocks crop out on the south side of the Bennett Mountains WSA. The Precambrian geology of both the Pedro Mountains and the Bennett Mountains WSAs is poorly known, and there is little published information available defining the variety of metamorphic rock types that are suspected in the area.

2.2 Physiography

The Pedro-Seminoe GRA occurs within the Wyoming Basin physiographic province, west and south of the Shirley Basin; the Bennett Mountains are located on the north edge of the Hanna Basin. The climate of the area is semiarid, with most of the precipitation occurring as snow during the winter months.

The elevation of the Pedro Mountains WSA ranges from 6,000 feet near Pathfinder Reservoir to 8,400 feet on the top of Heath Peak. The Bennett Mountains WSA ranges in elevation from 6,600 feet to 8,000 feet in the eastern plateau area.

2.3 Geologic Units

The geologic units exposed in the Pedro Mountains WSA are Precambrian granitic rocks overlain by unnamed Tertiary fluvial Miocene rocks similar to the Split Rock and Moonstone Formations near the Granite Mountains in west central Wyoming. The Bennett Mountains WSA is somewhat more geologically complex than the Pedro Mountains WSA in that Paleozoic and Mesozoic units crop out along the south side of the Bennett Mountains WSA. Tertiary (2-70 m.y.B.P.) sedimentary rocks have been identified only on the north side of the Bennett Mountains. Surficial deposits in the WSAs consist of pediment gravels that are found along the flanks of the ranges. The surficial deposits have not been mapped, but were identified during the field visit. Figure 2.1, "Geologic Map," delineates the bedrock formations that occur throughout the GRA. Figure 2.2, "Generalized Stratigraphic Column," is a generalized stratigraphic column which gives a brief description of all the stratigraphic units that underlie the Pedro-Seminoe GRA.

2.3.1 Bedrock Units

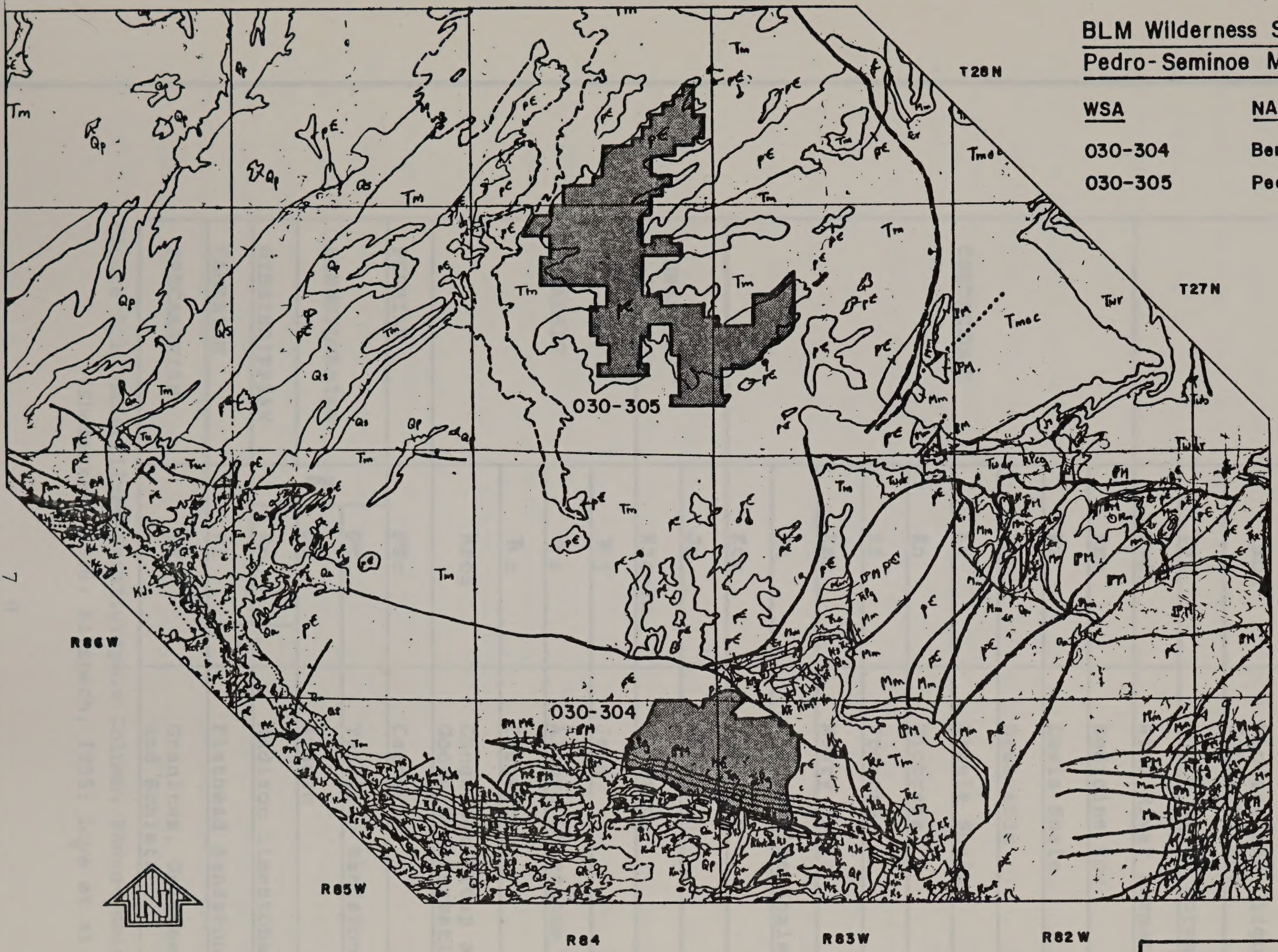
The major bedrock units that crop out within both WSAs and form the core of the mountain ranges are a series of Precambrian rocks. Numerous Precambrian rock types were identified during the brief field investigation, but no geologic maps are available which show the distribution of the various rock types that could be identified in the study area. The rock types that were identified in the study area during the field reconnaissance include granite gneisses, amphibolites, alaskites, amphibolite gneisses, and metadiabase dikes.

Overlying the Precambrian rocks is a Paleozoic section exposed along the south flank of the Bennett Mountains. The formations exposed include the Flathead Sandstone, Madison Limestone, Amsden Formation, Tensleep Sandstone, and Casper Formations.

The Flathead Sandstone Formation of Cambrian (500-600 m.y.B.P.) age consists of reddish-brown quartz pebble sandstones overlain by thick bedded massive limestones of the Mississippian (300-350 m.y.B.P.) Madison Limestone; the

BLM Wilderness Study Areas Included in the Pedro-Seminoe Mountains GRA

WSA	NAME	ACREAGE
030-304	Bennett Mountains	5,722
030-305	Pedro Mountains	5,990



(LOVE et al.,1979)

▨ Approximate Boundary of Wilderness Study Area

5 4 3 2 1 0 3 6 Miles

5 4 3 2 1 0 5 10 Kilometers

Pedro-Seminoe Mountains GRA, Wyoming

GEOLOGIC MAP

BLM GEM RESOURCES ASSESSMENT
REGION 6 WYOMING and MONTANA

TETRA TECH INC.
PASADENA, CALIFORNIA

FIGURE 2.1

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REVISIONS

SYSTEM		SYMBOL	FORMATION
QUATERNARY		Qs	Sediments
		Qal	Alluvium
	Qp	Qup	Upper Pediment Gravels
		Qlp	Lower Pediment Gravels
TERTIARY		Tm	Undivided Miocene
		Tmoc	Miocene and Oligocene Conglomerate
		Twr	White River Formation
		Twdr	Wind River Formation
CRETACEOUS		Kmb	Medicine Bow
		Kl	Lewis Shale
		Kmv	Mesaverde
		Ks	Steele Shale
		Kn	Niobrara
		Kf	Frontier
		Kmr	Mowry Shale
		Kt	Thermopolis Shale
		Kcv	Cloverly
JURASSIC		Jm	Morrison
		Kjs-Js	Sundance
TRIASSIC		R̄j	Jelm
		R̄a	Alcova Limestone
		R̄c	Chugwater
		T̄RPcg	Chugwater Group and Goose Egg Formation
PERMIAN		₱Pc	Casper
PENNSYLVANIAN	₱M	₱t	Tensleep Sandstone
		₱a	Amsden
MISSISSIPPIAN	M€	Mm	Madison Limestone
CAMBRIAN		€f	Flathead Sandstone
PRECAMBRIAN		p€	Granites, Gneisses, and Schists

Figure 2.2 Generalized Stratigraphic Column, Pedro-Seminoe GRA. (Shoemaker, 1936; Allspach, 1955; Love et al., 1979)

Mississippian Madison Limestone is approximately 100-400 feet thick. Above the Mississippian Madison Limestone, the Amsden Formation of Pennsylvanian (270-300 m.y.B.P.) age is exposed. The Amsden Formation is composed of gray dolomite, red and green shale, and thin gray sandstones. The unit is between 125-300 feet thick and is overlain by the Tensleep Sandstone. The Tensleep Sandstone consists of 220-330 feet of gray to buff crossbedded sandstone with a few cherty limestones near the base. The Permo-Pennsylvanian age Casper Formation overlies the Tensleep Sandstone. The Casper Formation consists of about 200-300 feet (estimate) of red and white sandstone, gray, hard persistant limestone, and red shale and siltstone.

Above the Paleozoic section that crops out in the Bennett Mountains WSA is the Mesozoic section. The Mesozoic section includes the Chugwater, Alcova Limestone, and Jelm Formations of Triassic (180-225 m.y.B.P.) age; the Sundance and Morrison Formations of Jurassic (135-180 m.y.B.P.) age; and the Cloverly, Thermopolis, Mowry Shale, and Frontier Formations of Cretaceous (70-135 m.y.B.P.) age. The southern boundary of the WSA is not accurately located. It is estimated that these formations include the youngest Mesozoic rocks exposed within the WSA.

The Chugwater Formation consists of about 300 to 1,000 feet of interbedded red to maroon siltstones and shales, with a few thin gray sandstones and the Alcova Limestone (approximately 10 feet) at the top. The Alcova Limestone is a prominent ridge/former and is readily identified in the field. Above the Alcova Limestone is the Jelm Formation. The Jelm Formation is Upper Triassic in age and consists of shaley sandstones.

The Jurassic rocks exposed in the study area include the Sundance and Morrison Formations. The Sundance Formation consists of about 300 feet of interbedded gray to pink sandstones, red and gray nonglauconitic sandstone, and shale with thin gypsum and limestone beds. A greenish-gray glauconitic shale and gray limey sandstone outcrop occurs in the study area as a low ridge in the upper part of the formation (field reconnaissance). The overlying Morrison Formation consists of 100-300 feet of dully variegated silty siliceous claystone and siltstone interbedded with gray to white silty sandstone.

The Cretaceous age rocks that underlie the GRA consist of the Cloverly, the Thermopolis Shale, the Mowry Shale, and the Frontier Formations. The Cloverly Formation consists of chert-pebble conglomerate and sandstone, lenticular variegated claystone, and a brown-weathering, fine-grained gray sandstone. The unit is approximately 100-300 feet thick. Overlying the Cloverly Formation is the Thermopolis Shale. The Thermopolis Shale consists of a black shale (approximately 100-200 feet), overlain by 50-100 feet of the Mowry Shale which consists of gray, lenticular, siliceous shale, that contains abundant fish scales. The overlying Frontier Formation consists of about 600 feet of coarse-grained quartz sandstone, interbedded with gray to black siltstone and shale, bentonitic and coaly in part.

The above descriptions characterize the Paleozoic and Mesozoic rocks that crop out within the GRA. Above these units, particularly in the Pedro Mountains WSA, Tertiary fluvial sedimentary units flank the outcropping of Precambrian rocks. The rocks consist of an unknown thickness of sandstones, siltstones, and shales that correlate to abundant Tertiary basin fill sediments in other parts of the state.

2.3.2 Surficial Deposits

The surficial deposits in the study area are sparse and consist primarily of thin alluvium associated with the tributary streams of the area. Talus deposits have developed at the base of cliffs, and thin pediment gravels associated with the early stage of drainage development also occur in the area.

2.4 Structural Geology

The Pedro and Bennett Mountains are ranges associated with the Sweetwater uplift and the north and south Granite Mountains fault system. During the Laramide orogeny (Cretaceous-Tertiary age), the uplift in this area caused considerable structural deformation in the adjacent Paleozoic and Mesozoic sedimentary rocks, considerable potassic alteration and metasomatic affects along the north and south Granite Mountain fault system, and the potential remobilization of uranium. Abnormally high background radiation has been

measured in the rocks of the Pedro Mountains along fractured zones, particularly in the Heath Peak area. Background radiation measurements of greater than 200 counts per second (cps) are not uncommon throughout the Pedro Mountains. (These measurements were taken in the Pedro Mountains during the field reconnaissance; measurements were not taken in the Bennett Mountains WSA). The high uranium background in the Precambrian rocks appears to be associated with a 1.4 - 1.8 billion year metamorphic event which caused the infusion of high radiogenic levels (Griffin and Milton, 1980). Later fracturing may have caused remobilization of mineralizing fluids which were particularly high in uranium content; these fluids may have deposited significant concentrations of uranium in favorable environments (i.e. Little Man Mine).

2.5 Engineering Geology

Geologic hazards typical of mountainous terrain are predominate in the WSAs. Rockfall hazards associated with the high mountain areas are common in both the Pedro Mountains and Bennett Mountains WSAs. Flash flooding in the tributary streams during periods of high runoff would be relatively common. In addition, problems associated with vehicle traffic during wet periods could occur in areas of the WSAs underlain by Paleozoic, Mesozoic, and Tertiary sediments which contain siltstones, shales, claystones, and tuffaceous sedimentary rocks.

2.6 Paleontologic Resources

Widespread occurrences of vertebrate fossils have been reported in the Jurassic and Cretaceous Formations in the region. Jurassic and Cretaceous rocks underlie part of the southern portion of the Bennett Mountains WSA. Tertiary vertebrate fossils have been identified in areas adjacent to the WSAs in rocks similar to those that lap up on the Pedro Mountains, and on the north side of the Bennett Mountains (Love, 1970). Paleontologic occurrences have not been identified within the boundaries of the WSAs.

2.7 Historical Geology

The geologic history of the area is similar to other areas of the Wyoming Basin Province (Fenneman, 1931). During Precambrian time, igneous, metamorphic, and sedimentary rocks were metamorphosed. Mineralization associated with premetamorphic events occurred early in the region's history. The metallic minerals that have a potential for occurring in the study area were deposited during the Precambrian. A later regional metamorphic event (1.4-1.8 billion years ago), infused high level radiogenic materials to the granitic rocks of the region prior to the beginning of the Paleozoic; this infusion made the granitic rocks both potential sources and hosts for uranium deposits.

At the end of Precambrian time and throughout the Paleozoic era, there were repeated advances and retreats of the sea. Marine deposits of sandstone, shale, and limestone were formed. At the end of the Paleozoic and into the early Mesozoic era, marine, marginal marine (evaporites), and terrestrial red-bed deposits were formed as the seas fluctuated over the area. The seas returned in Middle Jurassic time only to retreat by the end of the Jurassic period. A major marine invasion started in early Cretaceous time and continued until the start of the Laramide revolution near the end of the Cretaceous period. The Tertiary period was a period of repeated uplift and erosion (i.e. Sweetwater Uplift), and the deposition of terrestrial sediments. Uranium rich solutions percolated into and through the Tertiary sediments and concentrated in suitable reductant zones. Volcanism was active in the mid to late Tertiary time, and thick volcanic deposits accumulated locally and volcanic ash was widespread. The Quaternary (2-3 m.y.B.P.) period is noted for the development of stream generated deposits such as pediments, terraces, and alluvium derived from the erosion of the higher mountain areas.

3.0 ENERGY AND MINERAL RESOURCES

3.1 General

Of the two WSAs within the Pedro-Seminoe GRA, only the Pedro Mountains WSA contains an area with a known production of a mineral resource. The potential exists, however, in both WSAs for occurrences of uranium, iron, gold, metallic sulfides, and strategic minerals.

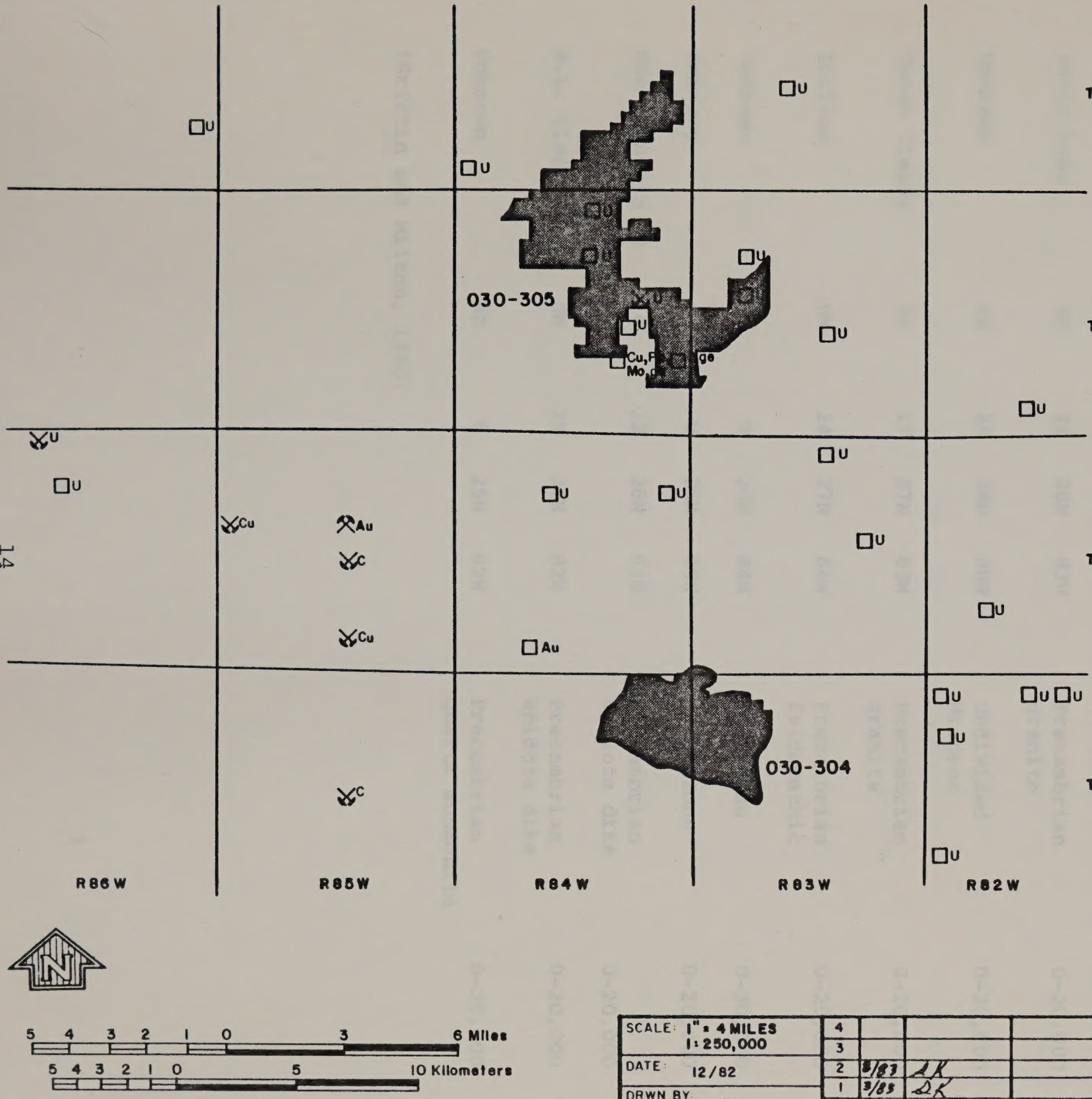
Figure 3.1, "Mineral Occurrence Map," illustrates the locations of any known past and present mines, and occurrences of mineral deposits and GEM resources within the GRA. Information for this figure came from the USGS' Computerized Resource Information Bank (CRIB); the USBM's Minerals Availability Information System (MILS); the Uranium Resource Evaluation, Casper Quadrangle (Griffin and Milton, 1980); and the Wyoming Mines and Minerals Map (Hausel et al., 1979).

3.2 Known Resources

The Pedro Mountains WSA contains the only known production of mineral resources in either of the two WSAs within the Pedro-Seminoe GRA. The Little Man Mine, located in the NW 1/4, SE 1/4, Section 14, T 27 N, R 84 W, 6 P.M., has produced (1954) a small amount of uranium and copper ore (Osterwald et al., 1966). An adit approximately 120 feet long follows a shear zone in which graphite rich schists in contact with a quartz monzonite are exposed. The uranium mineralization consists of kasolite, uraninite, and uranophane, with minor metallic sulfides such as molybdenite, chalcopyrite, and galena. The occurrence is considered autometasomatic in origin, and is the result of the remobilization of finely disseminated uranium along a shear zone (Griffin and Milton, 1980). This remobilization is possibly associated with a 1.4-1.8 billion year metamorphic event. Production of other commodities is unknown in the WSAs (Figure 3.1). Table 3.1, "Uranium Occurrences, Pedro-Seminoe GRA," lists the known uranium occurrences in the Pedro-Seminoe GRA as identified by Griffin and Milton (1980). A number of occurrences of graphite, copper, lead, and molybdenum are known to occur in the Heath Peak area of the Pedro Mountains (see Figure 3.1).

3.3 Potential Resources

Potential resources in the two WSAs include uranium in the Precambrian rocks of the Pedro Mountains and in the adjacent Tertiary fluvial sediments (Griffin and Milton, 1980), and gold, metallic sulfides, iron, and strategic minerals associated with greenstone type mineralization in the Precambrian rocks of the Bennett Mountains. The Madison Limestone may be a suitable source for calcium carbonate; the Madison Limestone crops out along the southern margin of the



BLM Wilderness Study Areas Included in the Pedro-Seminoe Mountains GRA

WSA	NAME	ACREAGE
030-304	Bennett Mountains	5,722
030-305	Pedro Mountains	5,990

●	Oil Well
☼	Gas Well
✸	Oil & Gas Well
⚒	Mine
⚔	Inactive Mine
■	Ore Body
◧	Deposit
☐	Occurrence
▨	Approximate Boundary of Wilderness Study Area

COMMODITY

U	Uranium
Cu	Copper
C	Coal
Au	Gold
Pb	Lead
Mo	Molybdenum
ge	Graphite

(USGS,1982; USBM,1982; Griffin & Milton, 1980; Hausel et al., 1979)

Pedro-Seminoe Mountains GRA, Wyoming

MINERAL OCCURRENCE MAP

SCALE: 1" = 4 MILES
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1	3/83	SK	

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REGION 6 WYOMING and MONTANA

TETRA TECH INC.
PASADENA, CALIFORNIA

FIGURE
3.1

Table 3.1
Uranium Occurrences
Pedro-Seminoe GRA

Name	Location 1/4 Sec.	Sec.	Twp.	Rng.	Host Rock Formation/Member	Production of U_3O_8 (in lbs.)
Unknown	SE	3	27N	84W	Precambrian epidote-rich	0-20,000
Chim Claims	NE	10	27N	84W	Precambrian	0-20,000
Little Man Mine	SE	14	27N	84W	Precambrian	0-20,000
Becky Lynn	NE	21	28N	83W	Precambrian granite	0-20,000
Unknown	SE	25	28N	86W	Undivided Miocene	0-20,000
Omega Claims	SE	17	27N	83W	Precambrian granite	0-20,000
Incline	NW	24	27N	84W	Precambrian feldspathic	0-20,000
Unknown	C	9	26N	84W	Mesaverde	0-20,000
Unknown	C	9	26N	86W	Fault Zone	0-20,000
Poe Mountain #2	C	12	26N	84W	Precambrian epidote dike	0-20,000
W.L. Claim	SW	29	26N	82W	Precambrian epidote dike	0-20,000
Unknown	NE	6	25N	82W	Precambrian quartz monzonite	0-20,000

(Griffin and Milton, 1980)

Table 3.1
Uranium Occurrences
Pedro-Seminoe GRA
(continued)

Name	Location 1/4 Sec.	Sec.	Twp.	Rng.	Host Rock Formation/Member	Production of U_3O_8 (in lbs.)
Country Line Claims		31	28N	84W	Precambrian	0-20,000
W.J. Sheppard	S	8	27N	83W	Precambrian	0-20,000
Big Bug Claim	S	22	27N	83W	Precambrian	0-20,000
Elk No. 1 Claim	S	33	27N	82W	Precambrian	0-20,000
Unknown	S	14	26N	83W	Precambrian	0-20,000
Unknown	S	3	26N	83W	Miocene and Oligocene Conglomerate	0-20,000
Beaver No. 1 Claim	S	4	25N	82W	Precambrian	0-20,000
A No. 1 Claim	S	3	25N	82W	Precambrian	0-20,000
Seminoe Dam	S	7	25N	84W	Precambrian	0-20,000
Chimney Rock Claims	S	30	25N	82W	Tensleep	0-20,000

(Griffin and Milton, 1980)

Bennett Mountains WSA. Jade and Beryl as gemstones are reported to occur in the area, but are unverified in the Pedro and Bennett Mountains area (Sherer, 1970; Sinkankas, 1976).

3.4 Land Status

Unpatented claims and oil and gas leases cover much of the GRA. Unpatented mining claims probably associated with uranium exploration cover much of the Pedro Mountains WSA; oil and gas leases cover much of the Bennett Mountains WSA. The oil and gas leases were probably filed based upon the slight potential for overthrusts along the north and south Granite Mountains fault systems. Figure 3.2, "Claim and Lease Map," illustrates the locations of any oil and gas leases, patented claims, and unpatented claims in the Pedro-Seminoe GRA. As shown, there are no patented claims in the WSAs.

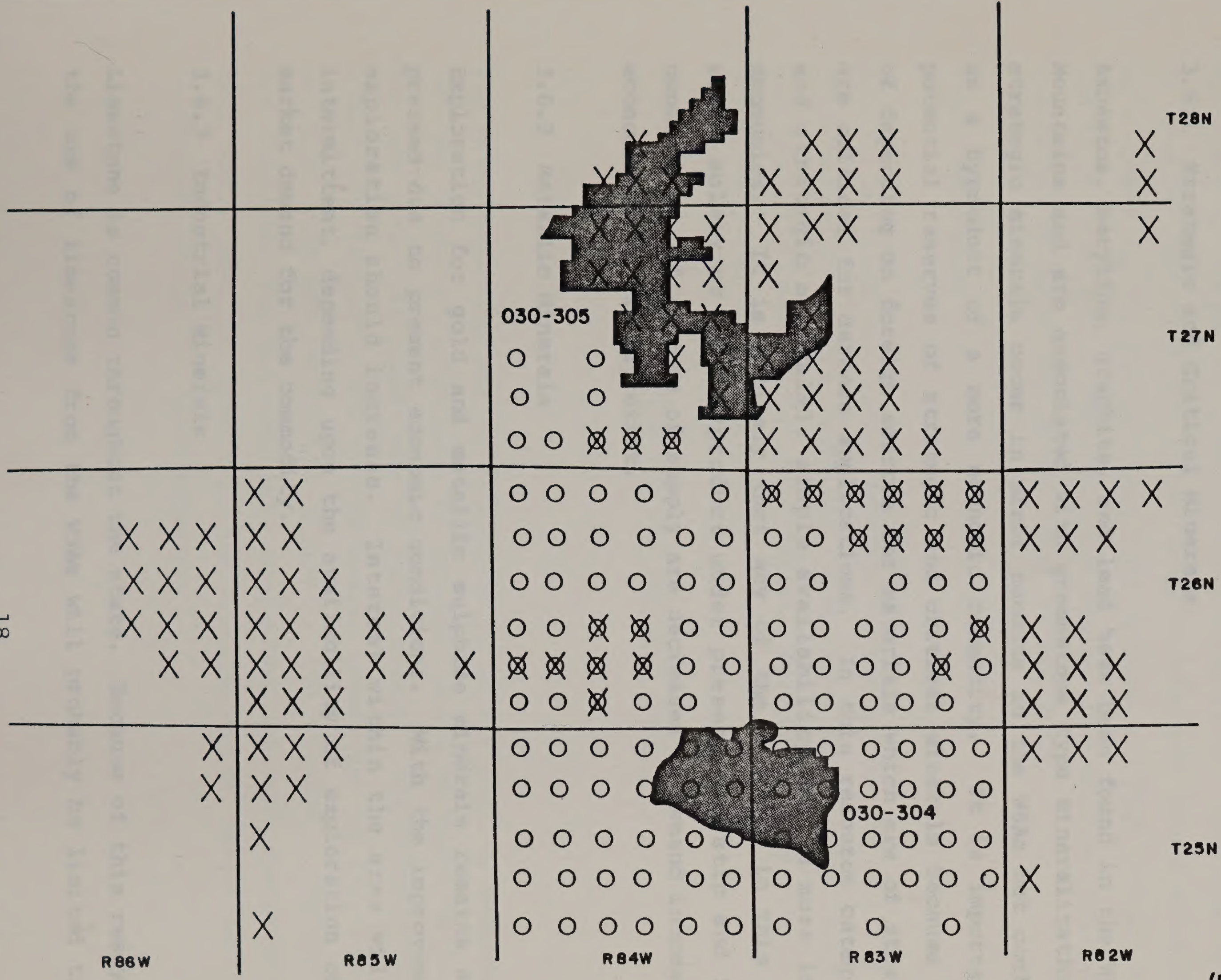
3.5 Deposit Types

The uranium mineralization in the Pedro Mountains is associated with the remobilization of finely disseminated uranium into concentrations suitable for mining. The past production of the Little Man Mine indicates that the potential for uranium occurrence is present and as such, the Pedro Mountains WSA should be considered favorable for the occurrence of high grade but probably small concentrations of uranium along shear zones. The remobilization of uranium from Precambrian metamorphic rocks during the Tertiary period has been proven by studies in the Granite Mountains area. The occurrence of potentially favorable host rock in the Tertiary units that surround the Pedro Mountains is considered high; this assumption is based upon favorable environments being identified in other areas where the same formations crop out and where potential economic deposits exist (i.e., Gas Hills, Crooks Gap).

The favorability of the Bennett Mountains WSA for the occurrence of gold, metallic sulfides, iron, and strategic minerals is based upon the occurrence in the WSA of certain rock types; these rock types occur in the Seminoe Mountains to the west where numerous gold prospects and iron ore reserves have been identified. Very little is known about the metamorphic petrology and petrogenesis of the rocks of the Bennett Mountains WSA because none of the

BLM Wilderness Study Areas Included in the Pedro-Seminoe Mountains GRA

WSA	NAME	ACREAGE
030-304	Bennett Mountains	5,722
030-305	Pedro Mountains	5,990



○ Oil & Gas Lease

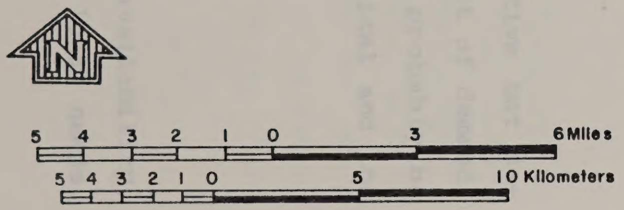
△ Patented Claim

X Unpatented Claim

▨ Approximate Boundary of Wilderness Study Area

NOTE: Symbols illustrate those sections where claims or leases are present.

(BLM,1982)



Pedro-Seminoe Mountains GRA, Wyoming

CLAIM and LEASE MAP

BLM GEM RESOURCES ASSESSMENT
REGION 6 WYOMING and MONTANA

TETRA TECH INC.
PASADENA, CALIFORNIA

FIGURE 3.2

SCALE: 1" = 4 MILES
1:250,000
DATE: 12/82
DRWN BY: SK
APRVD: WL

	DATE	DRWN BY	APRVD
4			
3			
2	8/83	SK	
1	2/83	WL	

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various Precambrain rock units have been mapped. The potential deposits in the area would occur as disseminations, beds, or veins in the metamorphic rocks. Beryl in the Bennett Mountains occurs as discreet crystals in pegmatites; these pegmatites are late stage crystallization features in the Precambrian rocks. Jade occurs as small isolated pods within the Precambrian metamorphic rocks of the Pedro and Bennett Mountains.

3.6 Resource Economics

3.6.1 Strategic and Critical Minerals

Asbestos, berylium, graphite, and lead have been found in the Western Seminoe Mountains and are associated with greenstone type mineralization. The above strategic minerals occur in minor amounts in the WSAs but could be produced as a byproduct of a more economic commodity. It is important to develop potential reserves of strategic and critical minerals because of the danger of depending on foreign sources for materials which are of strategic value or are critical for defense applications. In this resource category, (critical and strategic minerals), simple availability may be more important than economics. It is unlikely that any of the minerals in this area would be mined solely or as a byproduct under present domestic and foreign trade conditions. If sources of supply are decreased or demand increases, potential economic resources may exist.

3.6.2 Metallic Minerals

Exploration for gold and metallic sulphide minerals remains active but depressed due to present economic conditions. With the improvement of demand, exploration should increase. Interest within the area will probably be intermittent, depending upon the availability of exploration capital and the market demand for the commodity.

3.6.3 Industrial Minerals

Limestone is common throughout the state. Because of this ready availability, the use of limestone from the WSAs will probably be limited to local needs.

Limestone is a high volume, low cost commodity so that distance to market is a critical item when determining marketability.

3.6.4 Uranium

The current price of uranium (approximately $17 per pound in October, 1982) is low enough to discourage additional mining and exploration except for subsidized operations. A turnaround in national nuclear policy will be necessary to return the industry to profitability. Reserves far exceed demand at present and numerous mines with significant measured reserves of U_3O_8 have closed due to the low demand for uranium and high production costs. When and if nuclear policy and attitudes change, the uranium industry will recover slowly but probably not to the level of the 1970s.

3.6.5 Gemstones

Demand for jade and beryl depends primarily on the quality and physical characteristics of the material. Most deposits of these resources are small and generally operated by individuals. Significant deposits of gemstones are not anticipated within the WSAs.

4.0 LAND CLASSIFICATION FOR GEM RESOURCE POTENTIAL

4.1 General

The Pedro Mountains WSA is considered to have a high to moderate favorability for the potential occurrence of uranium, and a moderate to low favorability for the potential occurrence of other metals. The Bennett Mountains WSA is moderately favorable for the potential occurrence of iron, precious metals, metallic sulfides, strategic minerals, and uranium. Neither of the areas are favorable for oil and gas, geothermal, or coal resources; in addition, both areas have low potential for occurrences of industrial minerals (i.e. limestone) except for local purposes.

In order to better evaluate the occurrence or potential occurrence of resources in the GRA, a 2-part resource classification scheme has been adopted as requested by contract. Each resource or potential resource within the GRA will receive an alpha-numeric designation. The number designation will range from 1 to 4, and will indicate the favorability of the geologic environment, geologic processes, and mineral occurrences for the presence of a particular resource or group of resources. The letter designation will range from A to D, and will indicate the level of confidence to be associated with the numerical designation. Figure 4.1, "Land Classification Map," illustrates the areas of potential GEM resources with their assigned classifications for the WSAs within the Pedro-Seminoe GRA. Figure 4.2, "Resource Classification Scheme," provides a detailed description of the number and letter designations used in the resource classification scheme.

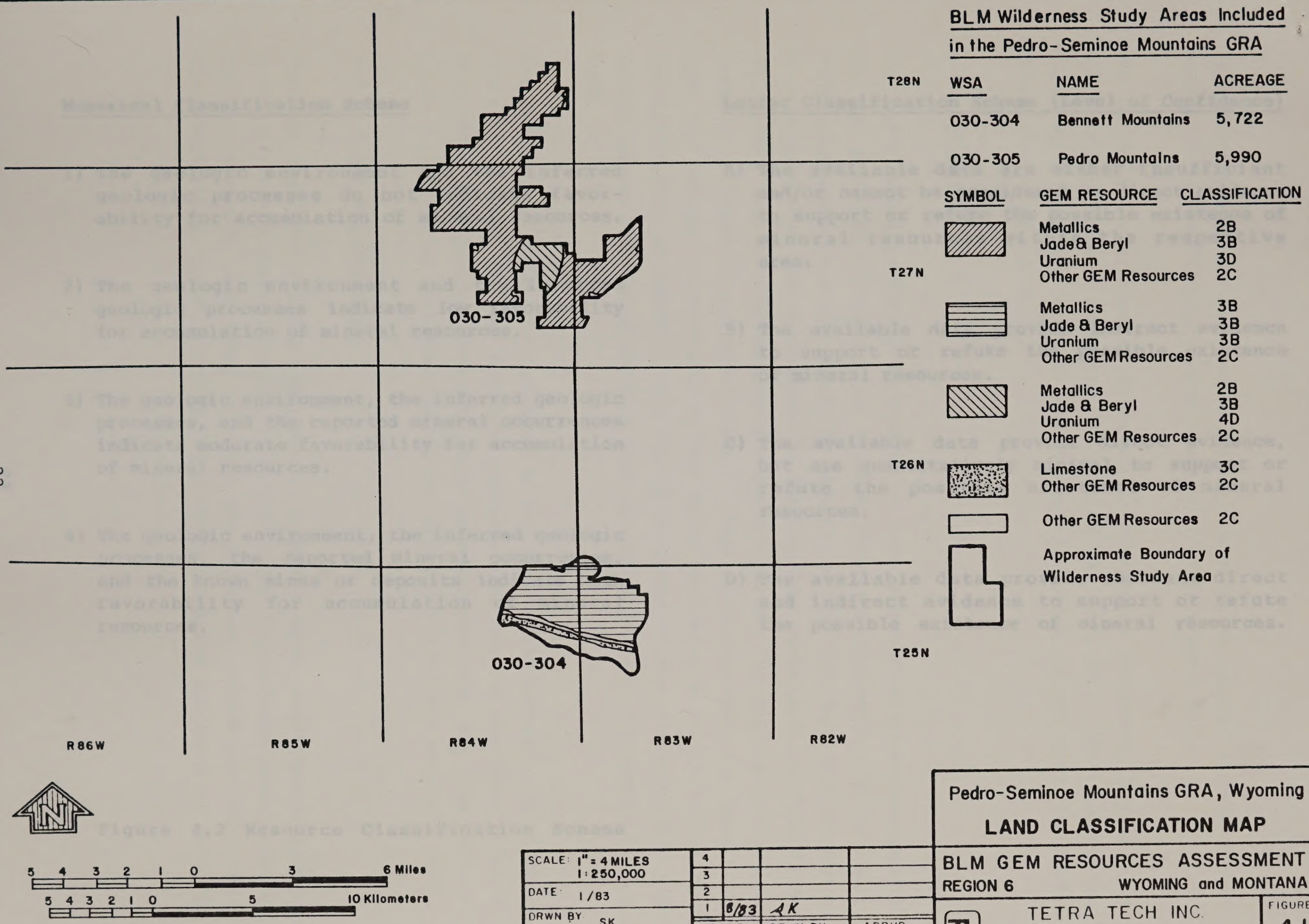
4.2 Metallic and Strategic Minerals

The Pedro Mountains WSA is considered to have a low favorability based on indirect evidence for the potential occurrence of metallic minerals (i.e. iron ore, gold, metallic sulfides), and strategic minerals (i.e. asbestos, graphite, beryllium and lead) (classified 2B). This classification is based on indirect evidence from reconnaissance geologic mapping (Love et al., 1979) and the brief field reconnaissance.

The Bennett Mountains WSA is considered to have a moderate favorability based on indirect evidence for the potential occurrence of metallic and strategic minerals (classified 3B). This classification is based on the probable occurrence of rock types in the Bennett Mountains similar to those which occur in the nearby Seminoe Mountains where occurrences of metallics and strategic minerals are known to occur.

4.3 Industrial Minerals

Both WSAs are considered to have a moderate favorability based on indirect evidence for the potential occurrence of gemstones (jade and beryl) (classified 3B); this classification is based upon the presence of favorable rock



BLM Wilderness Study Areas Included in the Pedro-Seminoe Mountains GRA

WSA	NAME	ACREAGE
030-304	Bennett Mountains	5,722
030-305	Pedro Mountains	5,990

SYMBOL	GEM RESOURCE	CLASSIFICATION
▨	Metallics Jade & Beryl Uranium Other GEM Resources	2B 3B 3D 2C
▤	Metallics Jade & Beryl Uranium Other GEM Resources	3B 3B 3B 2C
▧	Metallics Jade & Beryl Uranium Other GEM Resources	2B 3B 4D 2C
▒	Limestone Other GEM Resources	3C 2C
☐	Other GEM Resources	2C
☐	Approximate Boundary of Wilderness Study Area	

Pedro-Seminoe Mountains GRA, Wyoming

LAND CLASSIFICATION MAP

BLM GEM RESOURCES ASSESSMENT
REGION 6 WYOMING and MONTANA

TETRA TECH INC.
PASADENA, CALIFORNIA

FIGURE 4.1

SCALE: 1" = 4 MILES
1:250,000
DATE: 1/83
DRWN BY: SK
APRVD: WL

	DATE	DRWN BY	APRVD
4			
3			
2			
1	6/83	AK	

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Numerical Classification Scheme

1) The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.

2) The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.

3) The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.

4) The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.

Letter Classification Scheme (Level of Confidence)

A) The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.

B) The available data provide indirect evidence to support or refute the possible existence of mineral resources.

C) The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.

D) The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

Figure 4.2 Resource Classification Scheme

types for mineral occurrences, and upon references to similar mineral occurrences in the area (Sherer, 1970; Sinkankas, 1976) (Figure 4.1).

The potential occurrence of limestone is considered moderately favorable in the Southern Bennett Mountains WSA (classified 3C); this classification is based upon the occurrence of the Madison Limestone in the area (Allspach, 1955; Love et al., 1979).

4.4 Uranium

The Pedro Mountains WSA is considered to have moderate to high favorability for the potential occurrence of uranium resources (classified 3D and 4D); these classifications are based on abundant direct information. Potential uranium resources are classified 3D (or moderate potential) in Precambrian metamorphic and Miocene sedimentary rocks, and 4D (or high potential) in Precambrian rocks of the Heath Peak. These classifications are based upon high radiometric backgrounds in the Pedro Mountains granitic rocks, the identification of numerous uranium occurrences in the area (Griffin and Milton, 1980), and past production from the Little Man Mine (Osterwald et al., 1966).

The Bennett Mountains are considered to have a moderate favorability based on indirect evidence for the potential occurrence of uranium resources (classified 3B). This uranium resource would be associated with the Granite Mountains fault system and favorable rock types (Griffin and Milton, 1980).

4.5 Other GEM Resources

For both the Pedro Mountain and Bennett Mountains WSAs, there exists quantitatively minimal direct evidence to support a low favorability classification for the potential occurrence of other GEM resources (classified 2C). This classification is based on the geologic environment and the inferred geologic

processes that have been identified within the WSAs. The occurrence of paleontologic resources is considered moderately favorable in the Tertiary units within the WSAs.

5.0 RECOMMENDATIONS FOR FURTHER WORK

5.1 Work Recommended to Complete Data Base

A number of investigations could be implemented to generate additional data to supplement the conclusions of this Phase I report for the Pedro-Seminoe GRA. The geology of the Precambrian rocks in both WSAs is not well known at present. Adequate geologic maps need to be prepared that identify the distribution of the wide variety of rock types that are expected to occur within the WSAs. The rock types need to be characterized geochemically and evaluated to determine the potential resources that may be found within the area.

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